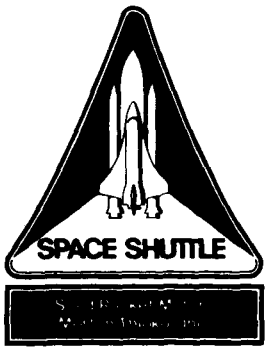

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EVALUATION OF CHEMLOK AIRBRUSH SPRAY APPLICATION

APRIL 1989

Prepared for:

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FINAL REPORT

APRIL 1989

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1.0 INTRODUCTION

Problems have occurred from edge separations in the RSRM capture feature area. Chemlok 205/233 is applied to the inboard surfaces of the capture feature during the normal spray application process. The Chemlok is sprayed onto the other bonding surfaces of the capture feature with an airbrush. Concerns have been raised as to whether the slight overspray of 205 onto the previously sprayed 233 causes bond degradation, and if the airbrush causes the Chemlok to be applied in such a dried condition as to degrade the bond.

Test results show that bond strengths are not decreased, except when both Chemlok 205 and 233 are applied at high viscosities with the airbrush. This application method causes much of the solvent in the Chemlok 205 and 233 to flash off, which causes the materials to appear dry and cause cobwebbing. The peel strength of the dry Chemlok bonds are decreased. The dry state is caused by the extremely high viscosity at which the Chemlok is applied.

2.0 TEST OBJECTIVES

1. To determine if Chemlok 205 overspray onto Chemlok 233 degrades the integrity of the NBR insulation to the RSRM case bond.

2. To determine if dry spray and cobwebbing degrades the strength of the NBR to RSRM case bond.

3. To establish dilution parameters to reduce the viscosity which in turn will provide wetter spray atomization and thus reducing cobwebbing and dry spray.

3.0 CONCLUSIONS

1. Most process excursions beyond the viscosity parameters tested of Chemlok 205 and 233 do not affect the strength of the NBR to RSRM bond.

2. When both Chemlok 205 and 233 are applied with an airbrush at high viscosities, there is a reduction in bond strength.

3. Normal overspray of Chemlok 205 onto 233 does not affect the NBR to case bond strengths.

4. On the lower strength peel specimens, the failure was cohesive in the rubber, but the failure was very close to the bond line. The higher strength peel specimens failed higher in the rubber. This indicates that although the failures were cohesive, out-of-tolerance Chemlok affects the rubber to steel bonds, weakening the ultimate strengths.

5. Dry spray is caused by high viscosities of the Chemlok which can cause weakened bond strengths. Dry spray can also be caused by low fluid flow rates, greater standoff distances, and the rate of travel of the airbrush. These variables make airbrush Chemlok application very operator dependent.

6. A lower viscosity will increase the sprayability of the Chemlok.

7. Multiple coats of 205, 233, 205, 233 do not degrade the bond strength of NBR to steel.

8. Touch up with a foam brush does not degrade the bond strength.

4.0 RECOMMENDATIONS

It is recommended that:

1. A small touchup gun (McMaster Carr Model No. 9535-T11) be used to decrease the possibility of dry spray during Chemlok application.

2. Spray viscosity be held to the lower end of the tolerance range with a #1 Zahn cup to reduce dry spray. The recommended tolerance range should be 35 to 39 secs.

3. The touchup gun should be held close enough to the metal surface as to ensure a wet coat of Chemlok.

4. During Chemlok application, the traverse speed of the touchup gun should be fast enough to keep the Chemlok from running and slow enough to ensure a wet coat.

5. When a touchup gun is acquired, testing should be done to determine the proper spray application parameters.

5.0 DISCUSSION

Testing has been completed in accordance with ETP-0433. Results show that the dry spray airbrush application is sensitive to viscosity, distance of airbrush to part, and application rate. It also decreases the NBR to metal bond strength.

Tests were run to determine at what viscosities dry spray occurs. At higher viscosities (45 secs and above), dry spray was easily obtained depending on standoff and application rate. At the lower limits (35 to 39 secs) of the acceptable viscosity range, dry spray will not be a problem if the operator is attentive to the job.

Bonding tests were performed on 8-in. X 10-in. panels. Five peel strips and eight tensile buttons were laid up on each panel. Two sets of 14 panels were run. The variables include high, medium, and low Chemlok viscosities, Chemlok 205/233 in multiple layers, and Chemlok applied with a foam brush in multiple layers. After the panels had been pulled, a visual inspection was made. The tensile samples did not seat well during layup because the spraying fixture was out of tolerance; therefore, a large variation was observed in the tensile strengths and the data were discarded. The peel samples performed well. Failure was almost completely cohesive in the rubber. However, the lower value peel strengths failed closer to the bond surface, leaving a very thin layer of rubber on the panel, and the higher value peel strengths failed toward the center of the rubber, leaving a much thicker layer of rubber.

This indicates that although the failure was cohesive, out-of-tolerance Chemlok affects the rubber causing a degradation in bond strength. This could be a contributing factor to edge unbonds. Hand brush touchup does not affect bond strength although it may dissolve the previously applied Chemlok; thus, reducing thickness in concentrated areas which can be sites for localized failure.

A statistical regression was performed by Advanced Engineering Design on the data. The results show that the only significant reduction in bond strength occurs when high viscosity Chemlok is used and applied extremely dry. The panels are sorted according to peel strength in Table II.

6.0 INSTRUMENTATION

6.1 Chemlok Spraying - An artist airbrush was used for all spray tests.

6.2 Chemlok Viscosity - The Zahn No. 1 viscosimeter cup was used in accordance with EOP No. E-1411.

6.3 Peel Testing - The Riehle Tensile Machine (Air Force Property No. 213887) was used to perform the peel testing.

6.4 Tensile Adhesion - The Baldwin Universal Tester (Property No. 213887), was used for the tensile adhesion testing.

7.0 PHOTOGRAPHY

Photographs were not deemed necessary for these tests.

8.0 **TEST DATA REQUIREMENTS**

1. Data are required to determine if the NBR-to-case bond degrades when Chemlok 205 is oversprayed onto Chemlok 233.

2. Data are required to verify and establish Chemlok viscosity parameters when using the airbrush to apply Chemlok.

9.0 **TEST IMPLEMENTATION** (See Test Matrix - Table I)

1. Grit blast all panels.

2. Degrease all panels.

3. Spray Chemlok 205 diluted with MEK to 45 seconds using a No. 1 Zahn cup.

4. Spray apply Chemlok 233 diluted with Xylene to 45 seconds using a No. 1 Zahn cup.

5. Repeat #3.

6. Repeat #4.

7. Spray Chemlok 205 diluted with MEK to 60 seconds using No. 1 Zahn cup.

NOTE

If Chemlok is unsprayable (excess cobwebbing), steps 7 and 10 will be deleted.

8. Same as #3.

9. Spray Chemlok 205 diluted with MEK to 30 seconds with a No. 1 Zahn cup.

10. Spray Chemlok 233 diluted with xylene to 60 seconds with No. 1 Zahn cup.

11. Same as #4.

12. Spray Chemlok 233 diluted with xylene to 30 seconds with a No. 1 Zahn cup.

13. Measure thickness of applied Chemlok with the Accuderm electronic thickness gage.

14. Perform NBR layup and cure in the normal manner of test panel preparation so that eight 1-in. peel strips can be cut. Use 0.30-in. thick NBR for all peel samples.

15. After cure, all panels will be tested at ambient conditions using a pull rate of 20 inches per minute at a 45 degree angle.

16. Report peel strengths and failure mode.

17. Use four panels with Chemlok 205/233, then touch up with foam brush with Chemlok 205/233.

Table I. Test Matrix

	STEP	PANELS* 1	2	3	4	5	6	7	8	9	10	11	12
1.	Grit Blast Panels	X	X	X	X	X	X	X	X	X	X	X	X
2.	Degrease Panels	X	X	X	X	X	X	X	X	X	X	X	X
3.	Spray 205 (45 sec)**	X	X	X									
4.	Spray 233 (45 sec)	X	X	X									
5.	Spray 205 (45 sec)		X	X									
6.	Spray 233 (45 sec)			X									
7.	Spray 205 (60 sec)				X	X	X						
8.	Spray 205 (45 sec)							X	X	X			
9.	Spray 205 (30 sec)										X	X	X
10.	Spray 233 (60 sec)				X			X			X		
11.	Spray 233 (45 sec)					X			X			X	
12.	Spray 233 (30 sec)						X			X			X
13.	Measure Thickness	X	X	X	X	X	X	X	X	X	X	X	X
14.	NBR Layup and Cure	X	X	X	X	X	X	X	X	X	X	X	X
15.	Peel Testing	X	X	X	X	X	X	X	X	X	X	X	X
16.	Report Test Results and Failure Mode	X	X	X	X	X	X	X	X	X	X	X	X

* Each number represents two panels

**All viscosities measured in seconds using a No. 1 Zahn Viscosimeter

Table II. Chemlok Airbrush Peel Data

	Panels*											
	1	2	3	4	5	6	7	8	9	10	11	12
Spray 205 (45 sec)**	X	X	X									
Spray 233 (45 sec)	X	X	X									
Spray 205 (45 sec)		X	X									
Spray 233 (45 sec)			X									
Spray 205 (60 sec)				X	X	X						
Spray 205 (45 sec)							X	X	X			
Spray 205 (30 sec)										X	X	X
Spray 233 (60 sec)				X			X			X		
Spray 233 (45 sec)					X			X			X	
Spray 233 (30 sec)						X			X			X
Peel Strength (PLI)												
Set A	202.5	205.1	207.2	186.4	187.6	197.9	196.5	203.5	195.2	204.6	207.9	201.5
Set B	202.6	205.8	197.3	155.1	207.8	191.5	195.0	198.4	183.0	186.3	196.6	187.7

Brush Touch Up
205/233-205/233

A) 182.6 pli
B) 192.9 pli
C) 203.2 pli
D) 207.2 pli

* Each number represents 2 panels

**All viscosities measured in seconds using a No. 1 Zahn Viscosimeter

DISTRIBUTION	M/S
R. B. Abrams	Elkton
R. D. Adams	B10
B. L. Anderson	431
L. G. Bailey	L10
S. J. Bennett	230
I. N. Black	L36
J. Braithwaite	L31
V. T. Bush	Huntsville
B. G. Butts	Longhorn
S. H. Cardall	243C
T. W. Carter	400
T. F. Christensen	203
G. J. Collins	203
R. L. Davis	E00
L. G. Dodd	KSC
N. F. Eddy	L21
J. W. Edwards	350
L. J. Evans	E12
E. L. Gray	L40
T. D. Hansen	411E
M. M. Hash	203
G. R. Jepson	L10
J. W. Jewell	203
W. B. Johnson	411
R. T. Kirkham	312
S. B. Kulkarni	L00
R. C. Laramee	286
R. D. Larsen	851
R. K. Lund	200
A. J. McDonald	G00A
B. D. Owen	Longhorn
P. C. Petty	L10
K. W. Phillips	Elkton
T. F. Pinkerman	MSFC
L. W. Poulter	243
S. A. Rolen	Louisiana
P. G. Russell	242B
L. E. Seidner	203
C. A. Speak	E12
G. Thompson	240
E. K. Troxell	W85
D. G. Turner	370
J. F. Twohy	L10
J. R. Wells	G00
C. R. Whitworth	L40
Process Engineering File	203
Technical Library	K21